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THE ORIGIN OF ANTHOPHILY AMONG THE COLEOPTERA.

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As pollinators of flowers the Coleoptera are less important than either the Hymenoptera, Diptera, or Lepidoptera. Of the total number of described species the majority are largely inhibited from visiting flowers by their forms or habits; many are predaceous both in the larval and adult stages, or are scavengers; others are nocturnal, or aquatic, or occur chiefly on the ground lurking beneath stones and boards, or living in the nests of other orders of insects; while round or elliptical forms with short legs and very large species are ill-adapted to anthophily. Knuth has enumerated 434 beetles in Europe and the Arctic regions as anthophilous;[1] and in the world outside of Europe 223 species, of which 185 belong to North America.[2] Since the appearance of Knuth's work a few partial lists of the species collected in various localities in the United States have been published. In Wisconsin Dr. Graenicher has recorded 35 beetles as visitors to the Compositæ;[3] in Virginia Dr. Banks has listed 58 species taken on the flowers of Ceanothus,[4] and in California Hopping collected 56 species on the same inflorescence;[5] while many additional flower-records are given in Blatchley's "Coleoptera in Indiana."

The order of the Coleoptera is of special interest, says Hermann Müller, since it shows so clearly the beginnings of anthophily, and the first corresponding modifications. In the most diverse families, accustomed to widely varying nourishment, single species have become habituated, first partially, then exclusively to a floral diet, and subsequently structural changes have been developed to insure greater success in the search after food. The length of time which has elapsed since the first tendency in a family toward anthophily is indicated by the number of species which resort to flowers. Where a whole family is dependent on a floral diet the epoch was more remote, but where there are only a few isolated species the habit has been acquired more recently.[1]

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[1] Knuth, Paul, "Handbuch der Blutenbiologie," Vol. 2, p. 560.

[2] *Loc. cit.*, Vol. 3, p. 366.

[3] Graenicher, S., "Wisconsin Flowers and Their Pollination," Bull. Wisconsin Soc. Nat. Hist., Vol. 7, pp. 19–77.

[4] Banks, N., "At the Ceanothus in Virginia," Ent. News, Vol. 23, pp. 102–110.

[5] Hopping, Ralph, "Some Notes of Coleoptera Found on Species of Ceanothus," Ent. News, Vol. 10, pp. 162–165.

During the past ten years Mr. C. A. Frost and the writer have devoted much attention to the anthophilous Coleoptera of New England. Mr. Frost has worked chiefly at Framingham, and the neighboring towns of Sherborn and Hopkinton, Mass.; while the writer has collected wholly at Waldoboro, Me. As a result a larger number of species has been taken than would have been obtained by a single observer working in one locality. In the appended list there are enumerated for New England 232 anthophilous species belonging to 127 genera and 29 families, or 47 species more than Knuth records for all North America. Of this number 185 species were collected in Massachusetts, and 102 in Maine, 57 species being common to both states, while two species are credited to New Hampshire only. The number of genera in Massachusetts is 100, and in Maine 73, with 46 genera common to both states. It is clear that all the families of marked significance in flower pollination in this section have been recorded, for 20 families, including 222 species, are common to both states, while each of the nine families listed from one state is represented only by a single species, or in one instance by two. Although further observations in other localities would add many species and genera to the list, there can be no doubt that the 46 genera common to both states cover most of the forms beneficial to flowers in northern New England. Where a large number of species in a genus, as in Lebia, Typocerus, Leptura, Strangalia, Telephorus, Hoplia, Trichius, Mordella, Mordellistena, and many others are known to resort to flowers, it is generally safe to conclude that the entire genus is anthophilous; but when a species has been taken only once it may be excessively rare, *e. g.*, a single specimen of Megapenthes rogersii was found on the flowers of *Viburnum alnifolium* in Maine and while this beetle has been reported from Canada and the southern shore of Lake Superior this is the only known record of its occurrence in New England. Where genera are represented in the list by a single species, if this form is very common it will be found recorded from more than one locality, as Chauliognathus pennsylvanicus and Epicauta pennsylvanica. The severe climatic and edaphic conditions in southern Maine, where the hills are covered with coarse glacial debris and the valleys with a subsoil of heavy clay, and sudden extremes in temperature and open winters prevail, are unfavorable to a rich insect fauna; and account for the larger number of anthophilous species collected in Massachusetts. The observations of Dr. Banks in Virginia would indicate that as we proceed southward the number of anthophilous Coleoptera would progressively increase.

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[1] Müller, Hermann, "Fertilization of Flowers," p. 36.

Loew has divided the anthophilous Coleoptera, according to their adaptations as flower visitors, into three groups termed by him hemipterous, allotropous and dystropous. The hemipterous beetles are partially adapted to visiting flowers, as the genera Chauliognathus, Gnathium, and Nemognatha. The allotropous species, which include the greater number of anthophilous Coleoptera, are of little value in pollination, and structural modifications for procuring nectar are indistinct or absent. This group is still further subdivided according to the food habits of the respective families both in the larval and adult stages. The dystropous beetles are detrimental or destructive to flowers, as the Chrysomelidæ, Rhyncophora, and the Melolonthinæ (a subfamily of the Scarabæidæ). While this arrangement is helpful in estimating the value of the Coleoptera in pollination we shall not follow it in the present paper; but shall take up the different anthophilous families in the order of their historical development. The sarcophagous Coleoptera, or where saprophagous living chiefly on decaying or dried animal substances, are certainly more primitive than the phytophagous families which feed on wood, sap, leaves and other vegetable matter; while in this second group the xylophagous families are apparently older than those living exclusively on foliage or a floral diet. In reviewing the rise of the anthophilous habit we shall consider, first, isolated anthophilous genera in sarcophagous families; second, genera in phytophagous families, of which the species occasionally or frequently resort to flowers, and finally families which are largely anthophilous.

ANTHOPHILY OF THE SARCOPHAGOUS FAMILIES.

Carnivorous families, especially where they live upon the ground or are aquatic, are not likely to visit flowers. None of the terrestrial Cicindellidæ (tiger beetles), or aquatic Dytiscidæ (water tigers), which are highly predaceous both in the larval and adult stages, have ever been observed feeding on pollen or nectar. Among the predaceous Carabidæ, or ground beetles, Lebia is the only genus which has become widely anthophilous.[1] Knuth, who saw *Carabus cancellatus* on the Island of Föhr devouring the flowers of *Thymus Serpyllum*, expresses the opinion that the most markedly predaceous beetles may occasionally visit flowers, but such visits are clearly accidental.[2] Frost in Massachusetts also saw *Harpalus caliginosus* eating the seeds of *Ambrosia artemisifolia.* Although living chiefly beneath stones, logs and rubbish, a part of the Carabidæ occasionally ascend plants in search of insect larvæ; thus Morris relates that he has "once taken *Calosoma scrutator*, and several times *C. calidum* on the foliage of the white pine, these enterprising ground beetles poaching on the arboreal preserves for caterpillars; many of the diurnal fireflies, which are carnivorous, may be found resorting to foliage for the same purpose."[3] Plant-lice and the pollen of grasses and the Compositæ have likewise been found in the stomachs of many species.[4] Nine species of Lebia, of which *L. ornata* and *L. viridis* are the most common, appear in the New England list; eight species have been collected on Solidago, a half dozen specimens being found at times on a single inflorescence; but a variety of other flowers are also visited as recorded. These small beetles still feed partially on Aphides and insect eggs, and it was undoubtedly the search for food on foliage which led to flower-visiting. The constriction of the head behind the eyes into a neck, and the fringe of hairs on the inner margin of the maxillæ cannot be regarded as special adaptations to anthophily, since the former occurs in Galerita which is wholly carnivorous, and the latter in genera which never visit flowers.

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[1] According to Blatchley, *Callida punctata* is often found on flowers. "The Coleoptera in Indiana," p. 152.

[2] Knuth, Paul, "Handbuch der Blütenbiologie," Vol. 1, p. 221.

[3] Morris, F. J. A., "Beetles Found about Foliage," Can. Ent., Vol. 43, p. 111.

[4] Blatchley, W. S., "The Coleoptera in Indiana," p. 37.

The Staphylinidæ, or rove-beetles, characterized by the short elytra, while partially saprophagous, are more generally carnivorous than is commonly supposed. Of the four anthophilous genera listed for New England, Anthobium, which includes very small beetles feeding largely upon pollen, is the most important. *A. pothos* has been taken by the writer devouring the anthers of *Clintonia borealis;* and in Indiana *A. convexum* is especially common on the flowers of the red-berried elder (*Sambucus racemosa*),[1] which is devoid of nectar (pollen flowers). The rich proteid content of pollen naturally renders it an attractive food to carnivorous beetles. The Carabidæ and Staphylinidæ well illustrate how difficult it is for predaceous families living upon the ground to acquire the anthophilous habit.

The larvæ of the Coccinellidæ are common on foliage where they feed chiefly on Aphides, while the beetles not infrequently resort to flowers, as is shown by the seventeen species listed. The tendency to seek floral food is most strongly manifested in the genera Coccinella and Hippodamia. In consequence of their short legs and round or oblong-oval forms the lady-bugs are exceedingly awkward and inefficient flower visitors, and are of little significance in pollination. They climb smooth stems with great difficulty and I have seen one of these beetles slip backward five or six times before it succeeded in ascending a pedicel of an umbel of *Aralia hispida.* After examining the contents of the stomachs of 39 species Dr. S. A. Forbes concluded that "the function of the beetles of this family of limiting the multiplication of plant-lice is expressed by the fact that these insects compose a fourth of the food of the entire collection. The pollen of grasses and the Compositæ make 14 per cent. and the spores of lichens 4 per cent. and those of fungi 45 per cent., or nearly half the whole." [2] While the Coccinellidæ consume a much larger quanity of pollen and spores than of nectar, they may be found occasionally sucking on small open flowers.

Ten species of the Dermestidæ, so destructive to decaying animal substances, skins, dried insects, feathers, woolens and carpets, have been taken in New England on flowers. Like the Coccinellidæ their visits are chiefly for pollen, and they are not infrequently found on pollen flowers, as Rosa, Anemone, and *Thalictrum polygamum.* The genera which are anthophilous are usually those which contain very common species, as Anthrenus and Attagenus. Comstock says of the carpet beetle (*Anthrenus scrophulariæ*) that in its adult stage it feeds on the pollen of flowers, and sometimes abounds on the blossoms of currant, cherry and other fruits.[1] The little white larvæ of *Byturus unicolor* infest the fruit of the raspberry, and the small, pale brown beetles often visit the flowers. Cryptorhopalum is common on the blossoms of Cornus, Viburnum, Spiræa and Solidago; but most of the genera may live indefinitely without making flower visits.

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[1] Blatchley, W. S., "The Coleoptera in Indiana," p. 487.

[2] "Coleoptera in Indiana," p. 507.

The Nitidulidæ are called sap-feeders since they may be found in great numbers in spring at sap flowing from the trunks of trees; but many species live in fungi, or devour dry animal and vegetable matter, and the larvæ of a few genera, as Ips and Carpophilus, are carnivorous so that the family constitutes a transition group. The mature beetles readily feed on nectar or the juices of fruits, and as they are of small size are able to creep into tubular corollas; but usually they are taken on flowers with visible nectar. Of the five genera which appear in the New England list, Carpophilus, Cercus, and Epuraea are the more important. In Europe Knuth enumerates more than 150 flowers which are visited by Meligethes, this being one of the few genera the larvæ of which live on flower food.[2] The Nitidulidæ also visit pollen flowers, as Rosa, Sambucus, Anemone and Papaver.

The familiar fireflies, or Lampyridæ, are carnivorous both in the larval and adult stages; the larvæ live chiefly on the ground, but the mature beetles may generally be found on the stems, under the bark, or on the foliage of trees, shrubs, and herbage. As in the Carabidæ many genera are nightflyers, which lessens the probability of their becoming anthophilous; but the species are more common on foliage than the ground beetles and are consequently more frequently taken on flowers. The New England list contains 18 species as against 15 recorded by Knuth for Europe and the Arctic regions. The genera Lucidota, Ellychnia and Podabrus search for plant-lice and insect larvæ on vegetation, and often visit densely clustered inflorescences with visible nectar, as Cornus, Viburnum, *Spiraea salicifolia, Pyrus arbutifolia, Prunus virginiana* and *Achillea Millefolium.* The anthophilous tendency is more strongly marked in Telephorus, which, although still remaining partly predaceous, includes nine species taken on flowers.

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[1] Comstock, J. H., "Manual of Insects," p. 540.

[2] Knuth, Paul, "Handbook of Flower Pollination," translated by J. R. Ainsworth Davis, Vol. 1, p. 185.

Special interest attaches to Chauliognathus, one of the few genera of the Coleoptera, which have become modified in structure as a result of anthophily. The mature beetles live wholly on a floral diet, but the larvæ still retain the carnivorous habit. The species are diurnal, the head is long and prominent instead of being retracted under the thorax as is common in this family, and the maxillæ are extensile with the outer lobes prolonged into an oblong pointed process. The modified maxillæ are able to suck nectar in flowers where it is concealed at a depth of one or two millimeters. *C. pennsylvanicus* is very common on the Compositæ, especially on the flowers of Solidago; while *C. marginatus*, occurs in Indiana, according to Blatchley, by thousands on the flowers of the linden, Jersey tea, and wild hydrangea, and in Virginia, according to Banks, is very abundant on Ceanothus. All of the anthophilous species of the Lampyridæ feed on pollen as well as nectar.

The Cleridæ live chiefly on insect larvæ found on vegetation, and are predaceous in both the larval and adult stages. It is a misnomer to call these handsome beetles flower beetles since only nine species have been observed on flowers, of which four belong to the genus Trichodes; many species are rare and little is known of their habits. Trichodes restricts itself wholly to a floral diet.[1]

The series of carnivorous families may be closed with the Malachiidæ, all the species of which are stated incorrectly by Knuth to live solely on flower food when they are adult. The family is of small extent and is sometimes incorporated with the Lampyridæ to which it is closely allied. The larvæ are carnivorous, and most of the genera in the mature stage may be found on foliage hunting for plant-lice and insect eggs; but Attalus, Collops and Malachius and probably many other genera frequently visit flowers for pollen and nectar. Four genera and five species are listed for New England. Very little is known about the habits of the majority of these small beetles.

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[1] Müller, "The Fertilization of Flowers," p. 33.

In reviewing the carnivorous Coleoptera it has been repeatedly shown that anthophily prevails to a much greater extent in those families which seek their prey on vegetation than in those which live wholly on the ground; and among the former there may occur genera which both in the larval and adult stages feed on flower food alone. In only one genus, Chauliognathus, have the mouthparts become specialized for sucking nectar. Comparatively few species are anthophilous and owing to the irregularity and uncertainty of their flight they are of little value in pollination; but on the other hand they are detrimental only to a small extent. They have been taken chiefly on small densely aggregated flowers with visible nectar, or nearly visible nectar, as Cornus, Viburnum, Rhus, Spiræa, Fragaria, Rubus, Cratægus, Pyrus, Prunus, Ceanothus, Daucus, Solidago, and a variety of other umbelliferous and composite flowers. They also often visit pollen flowers, as Rosa, Anemone, Papaver and Sambucus; but in general they feed more freely on pollen than nectar, partly because it is more easily obtained, and partly perhaps because it more nearly resembles in its chemical composition the animal food to which they are accustomed. Since all of the anthophilous genera and probably most of the anthophilous species have evidently acquired this habit independently, it may be inferred that the sarcophagous families had very nearly attained their present stage of development before they began to visit flowers.

Anthophily of the Phytophagous Families.

Among the families, which live upon vegetable substances both in the larval and adult stages, anthophily assumes much greater importance than among the carnivorous forms. The phytophagous species are naturally brought into proximity with flowers, and it is an easy step to acquire the habit of feeding on pollen and nectar; but in a vast number of tubular and zygomorphic flowers the nectar is so deeply placed that it is beyond the reach of beetles. The larvæ of the Elateridæ or click beetles, infest the roots of grains and grasses; while the adult beetles live under the bark, or on the foliage of trees or herbage, and are, according to Morris, very fond of sunshine. The New England list contains 13 genera and 39 species,—a greater number than Knuth enumerates for Europe and the Arctic regions. The convex head is deeply inserted in the thorax and permits the Elateridæ to feed only on exposed nectar; accordingly, the common genera Agriotes, Corymbites, Elater and Melanotus are found chiefly on the inflorescence of Rubus, Viburnum, Prunus and Cornus.

The Buprestidæ, which superficially resemble the Elateridæ, are most abundant in the tropics and are of little significance in pollination either in Europe or North America. The larvæ are wood-borers, and the mature beetles live on vegetation. A single species (*Acmaeodera tubulus*) has been taken in New England by Frost on the flowers of Geranium, Viburnum and Rubus; the same species, according to Blatchley, is very common in Indiana on *Geranium maculatum*. Knuth lists only three species of this family for North America.

The leaf-beetles or Chrysomelidæ have attained their highest development in the more recent periods according to Leconte and Horn;[1] the species are diurnal, of small or medium size, and are classed as dystropous by Loew. In both the larval and adult stages this family is very destructive to foliage, and the ravages of the potato beetle have been little less than a national calamity. Since their round or oval forms, retracted head partially or wholly concealed beneath the thorax and short legs, are ill-adapted to anthophily, the New England list contains only 20 species belonging to 16 genera. It is clearly impossible for this immense family of ravenous feeders to become exclusively anthophilous, for the flower food available would be wholly inadequate to their requirements; but there are, doubtless, a large number of occasional visitors. No genus in America is more common or has been taken on a greater variety of flowers than Diabrotica.

The entire life cycle of many leaf-beetles is passed on a single plant species or genus. *Donacia piscatrix* is found in the flowers of *Nymphœa advena*, while the larvæ mine in the stems and leaves. *Donacia emarginata*, near New York City, is very common on the bright yellow flowers of *Caltha palustris* half buried among the stamens. The pupal cocoons are attached to the stems just above the roots, and the beetles emerge as the flowers expand and climb the stems to obtain flower food.[2] All of the species of Donacia are commonly found on aquatic or marsh plants. *Crio-*

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[1] Blatchley, W. S., "The Coleoptera in Indiana," p. 1096.

[2] Woodruff, L. B. "*Donacia emarginata*," Can. Ent., Vol. 45, p. 210.

cerus asparagi visits the flowers of the cultivated asparagus, and the larvæ devour the vegetative organs; *Chalepus dorsalis* visits the flowers of the black locust (Robinia) and the larvæ mine the leaves; while both stages of the Colorado potato beetle are familiar on the flowers and foliage of the potato.

Both the New England list and Knuth's list for North America contain only two species of the Bruchidæ. This small family is closely allied to the Chrysomelidæ; but the larvæ live in seeds, chiefly those of leguminous plants, while the beetles occur on foliage and occasionally on flowers.

In accordance with their food habits the Scarabæidæ are popularly divided into two large, well-defined groups, the scavengers and leaf-chafers. The scavengers are largely ground forms feeding chiefly on dung, a few on fungi and a few on animal substances. They seldom visit flowers, but on one occasion I captured the common *Aphodius fimetarius* on the flowers of *Spiræa salicifolia*. The leaf-chafers, or Melolonthinæ, to which belong the genera Hoplia, Macrodactylus and the nocturnal Lachnosterna, are dystropous forms frequently defoliating shrubs and trees. Hosts of rose-chafers (*Macrodactylus subspinosus*) often strip rose bushes and other shrubs of both flowers and leaves, or devour the blossoms and ruin the crop of grapes. But *Hoplia trifasciata* "is almost entirely a pollen feeder like *Trichius piger* and *Euphoria inda*,"[1] and visits a great variety of flowers. The behavior of *T. piger* on *Iris versicolor* has been described by Needham: "The species is not ill-adapted by its size for visiting these flowers, and, should it pass from flower to flower, it might be an important agent in pollen distribution; but I have not seen one pass from flower to flower directly and am inclined to think it rarely does so. It is little disposed to flight and is much more at home clambering among the thyrsoid clusters of Rhus and Ceanothus. Furthermore, on reaching an Iris flower it is habitually deceived as to the point of entrance and tries for some time to get in at its center, between the branches of the cleft style." In warm regions the Cetoniæ are important flower visitors, and Delpino formerly regarded them as the chief pollinators of Magnolia. We have taken 11 species of the Scarabæidæ on flowers in New England, and Knuth lists only

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[1] Morris, F. J. A., "Beetles Found about Foliage," Can. Ent., Vol. 43, p. 115.

10 species for North America—a very small number certainly in comparison with the great size of this family.

The snout-beetles, or Rhyncophora, an immense group of beetles highly injurious to vegetation, also includes few anthophilous species. The larvæ feed on roots, mine underbark, but chiefly live in nuts, fruits and seeds, while the adults are found mostly on leaves, only 18 species having been observed on flowers in New England. Two common species are the plum weevil (*Conotrachelus nenuphar*), which sometimes destroys the plum and cherry crop, and is common on the flowers of *Prunus virginiana*; and the blue-flag weevil which passes its entire life on the blue flag (*Iris versicolor*). The economy of the blue-flag weevil (*Mononychus vulpeculus*) has been very fully described by Prof. Needham;[1] the larval stage is passed within the seed capsule where the transformation into the imago takes place, and both beetles and seeds are set free by the bursting of the capsule in the fall. This weevil wastes the nectar inordinately. It makes many punctures in the nectariferous tissue from which the nectar continues to flow, attracting swarms of insects of all kinds. Eight species of beetles were observed feeding at the punctures, besides many flies. The flag weevil picks up stray grains of pollen but it is of no importance in pollination. "It has become adapted to living on the blue flag exclusively." The life history of many other snout-beetles is confined to a single plant species, but as pollinators they are of little importance and are classed among the dystropous forms.

To the floroecologist no family of the Coleoptera is of greater interest than the Cerambycidæ, or wood-borers, a group the origin of which dates back to an earlier period than that of the Chrysomelidæ. This is partly because it contains many species, which wholly or partially depend on a floral diet; and partly because of modifications resulting from the anthophilous habit. For New England 39 species are enumerated, while Knuth lists 29 for North America, and 42 for Europe and the Arctic regions. Many genera of the tribe Lepturini, as Pachyta, Gaurotes, Typocerus, Leptura and Strangalia, feed entirely on flower food. Nineteen species of Leptura have been collected on flowers in New England, the largest number ever recorded, and no doubt the entire genus is anthophilous. As in 41 instances the species were observed by the writer sucking nectar on the flowers of *Aralia hispida* and in only two cases eating pollen, they would appear to manifest a preference for nectar, as do the allied genera Typocerus and Strangalia. Both lobes of the maxillæ are fringed with long bristly hairs, which enables them to lick up nectar easily. But pilosity of the maxillæ, either of one or both lobes, must not be regarded as a character peculiar to the Lepturini; for, according to Leconte and Horn, the entire family of the Cerambycidæ is characterized by having "the maxillæ furnished with bristles." At my request, Frost examined species belonging to 13 tribes, found in North America, and in all cases there were bristly hairs on the apices of the maxillæ. All, therefore, that can be claimed for the Lepturini is that the maxillary hairs are in general longer and less bristle-like than in other tribes; and this statement is sustained by the examination of microscopic preparations of the maxillæ of various species. It was further believed by Müller that the elongation of the head forwards, a neck-like constriction behind the eyes and consequently the power to direct the head forwards, and the prothorax elongated and narrowed anteriorly were structural characters acquired for feeding on nectar whether superficially or more deeply placed.[1] These conclusions, although they have long been accepted without question, appear to the writer doubtful. In Müller's time structural modifications, which enabled insects to obtain flower food, were readily assumed to have been developed specially for that purpose, often without careful consideration that they might have been determined at an earlier period by the habits of the insect.

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[1] Needham, James G., "The Fruiting of the Blue Flag (*Iris versicolor* L.)," Amer. Nat., Vol. 34, p. 370.

The Lepturini are wood-borers and their narrow cylindrical forms have been determined by their well-known economy. The transformations of the larvæ take place in their burrows in the solid wood, and the imagoes are compelled to gnaw their way to the surface, for which purpose an elongated head which could be directed forwards would be a great advantage. Moreover a constriction of the head behind the eyes occurs in beetles which are unknown on flowers. The form of *Leptura vittata* is very narrow (a specimen before me is 3mm. wide and 14 mm. long) and the elongated thorax is correlated with the elongated cylindrical abdomen; in *L. chrysocoma* the abdomen is broader and the thorax is also shorter and more robust; in Strangalia again the elongated thorax is correlated with a long slender abdomen.[1] While the cylindrical forms of these beetles are an advantage in visiting flowers, the genera of the Lepturini were probably essentially differentiated before they became anthophilous. The influence of insect economy in modifying the structure of the head and thorax is well illustrated by the Rhyncophora, which are, as has been shown, of little significance in pollination. The front of the head is prolonged into a slender beak, and in some species the head behind the eyes is constricted into a neck, and the thorax is elongated and narrowed anteriorly. But in this group it is clear that the morphology of the head and thorax was very early determined in its phylogenetic history by the habit of excavating the little pits in which the eggs are laid.

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[1] Müller, H., "The Fertilization of Flowers," p. 35.

But in the genera Gnathium and Nemognatha of the Meloidæ there occur undoubted modifications of the mouthparts for obtaining nectar. The blister beetles at times appear suddenly, and *Epicauta vittata* may destroy large areas of tomatoes and potatoes in a few days. An extended list of the plants on which these beetles feed is given by Gibson in the fourty-second annual report of the Entomological Society of Ontario. In New England only three species of this family have been observed on flowers, but *Epicauta pennsylvanica* is very common on the flowers on Solidago. Gnathium and Nemognatha, southern and western genera living wholly on nectar, have the maxillæ prolonged into a slender suctorial tube, resembling a lepidoterid tongue. The length of this suctorial tube has been measured in 14 species of Nemognatha, and showed a gradual increase from 1.5 mm. to 10 mm. in length, presenting a complete series of intermediate gradations.[2] *N. vittigera*, according to Graenicher, visits the flowers of the Compositæ exclusively, chiefly those of *Rudbeckia hirta*. This observer states that the behavior of these beetles when at work on flowers presents additional evidence of a high degree of adaptation, the tongue being thrust in and removed from the florets with great precision and little loss of time. This is easily the most remarkable modification that anthophily has induced among the Coleoptera; and the origin of a tongue, adapted for sucking nectar, varying greatly in length in the different species, in these two genera, presents a problem difficult of explanation.

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[1] This view is favored by Cockerell's observations on the bee genus Perdita. He states that the length of the tongue appears to have increased or decreased according as the total size of the bee has increased or decreased, not to meet special requirements. "The Bees of the Genus Perdita," Proc. Acad. Nat. Sci. Philadelphia, Vol. 48, p. 40.

[2] Graenicher, S., "On the Habits of Beetles of the Genus Nemognatha," Ent. News, Vol. 21, pp. 72–75.

There remain for consideration several small families, as the Œdemeridæ, Mordellidæ and Anthicidæ, which to a great extent in the adult stage live on flower food; but they do not in any other sense represent the culmination of anthophily among the Coleoptera. The prevalence of anthophily in these families is to be attributed to the comparatively few species, their small size, and the ease with which they can obtain food and shelter in densely clustered small flowers. They exhibit very obscure if any modification of the mouthparts for procuring nectar. The wedge-shaped Mordellidæ are very common, and Frost found the compound cymes of Viburnum loaded with species of Mordella and Anaspis; they may also be found on the inflorescence of Cornus, Prunus, and Spiræa and on the pollen flowers of the wild rose. The New England list contains 12 species, while Knuth records 12 species for Europe and 15 for North America. Only one species of the Œdemeridæ (*Asclera ruficollis*) has been observed on flowers in New England.

FLOWERS VISITED BY THE ANTHOPHILOUS COLEOPTERA.

While many of the more important flowers visited by the anthophilous Coleoptera have been mentioned in the preceding pages a brief recapitulation of their mutual relations in New England is desirable. The largest number of species of beetles have been collected on the following genera and species of plants: Viburnum, 81; Cornus, 38; *Spiræa salicifolia*, 42; *Amelanchier canadensis*, 31; *Prunus virginiana*, 43; *Pyrus arbutifolia*, 10; *Ceanothus americanus*, 13; *Aralia hispida*, 9; and Solidago, 30 species. All these flowers have the nectar fully exposed, or only slightly concealed, as in Solidago which has a floral tube 1 mm. long, or a little longer in *S. lanceolata*, and are of small size, densely clustered and very common. The phenomenal number of beetles taken on Viburnum may be partially explained by the great abundance of the flowers, the form of the cymes and the time of anthesis. In a warmer climate the anthophilous Coleoptera would doubtless show a large increase, for, in Virginia, Banks collected 58 species on the flowers of Ceanothus, and Hopping reports 56 species taken on the same genus in California. In Virginia, Chauliognathus was most common, while hosts of small Mordellids, and *Centrinus picumnus*, *Macratria murina*, *Lappus sturmii*, *Mycterus scaber*, *Isomira sericea*, were always abundant. Eighteen species of Cerambycidæ were obtained, and eleven species were taken at one patch of flowers in less than an hour. In the flowers enumerated nectar is a more important allurement than pollen, which is not produced in large quantities.

In Wisconsin, Graenicher collected 35 species of Coleoptera on the capitula of the Compositæ, but the only genus on which they were common was Solidago.[1] In New England 30 species have been taken on Solidago, 7 on *Eupatorium perfoliatum*, 4 on Aster, 6 on *Chrysanthemum Leucanthemum*, 1 on *Taraxicum officinale*, 6 on *Achillea Millefolium*, and 1 on *Diplopappus umbellatus*. Where the nectar is deeply concealed the beetles usually feed on pollen, *e. g.*, two species taken by Graenicher on the heads of *Cirsium lanceolatum*, which has a floral tube 6 mm. long were both eating pollen. In the New England list some thirty other flowers are enumerated which are visited by beetles in small numbers. The nectariferous species, as Salix, Daucus Carota, *Zizia aureum*, Brassica, Rhus, Veratrum, Ranunculus, etc., for the most part have the nectar easily accessible.

Beetles also frequently visit flowers which are devoid of nectar, to obtain pollen. Many anemophilous flowers are sought by beetles in search of pollen, as the staminate cones of *Pinus sylvestris* and *Picea Abies*[7]; numerous beetles, which devour the anthers as well as the pollen, may be swept from the grasses; while others have been collected on the inflorescence of the Cyperaceæ and Juncaceæ. Cistela sericea was found by Frost on the aments of Castanea, upon which two beetles were also taken by Knuth. Flowers intermediate between anemophily and entomophily, as Vitis and Plantago, are freely visited by Coleoptera. Beetles are likewise common on conspicuous pollen flowers, as Rosa, Anemone, Clematis, Adonis, Papaver, Hypericum and Sambucus; and not always content with the pollen they may destroy the entire corolla,

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[4] Graenicher, S., "Wisconsin Flowers and Their Pollination," Bull. Wisconsin Nat. Hist. Soc., Vol. 7, pp. 19–77.

e. g., *Nodonota puncticollis* is very destructive to the petals of the rose.

The frequency with which anthophilous Coleoptera visit pollen flowers led Knuth to infer that they exhibit a marked preference for pollen.[1] That carnivorous forms, like the Coccinellidæ which live largely on Aphides and insect eggs, find pollen a more agreeable food than nectar is not improbable; but if this were generally true of all anthophilous genera then Nemognatha and Gnathium would not have become adapted to feeding on nectar alone. My observations lead me to believe that Chauliognathus, Leptura, Typocerus, Strangalia, the Mordellids and many others manifest a preference for nectar. But genera, as among the leaf-chafers, which occur in enormous numbers must as a necessity feed upon pollen as well as nectar and also on the succulent parts of the plant.

Coleoptera are occasionally taken on zygomorphic or bilabiate flowers with the nectar deeply concealed, where they are either searching for food or their presence is accidental. According to Kerner beetles of the genera Anthobium, Dasytes, and Meligethes find refuge and shelter in the interior of the gentians, while species of Cetonia remain for several days in the partially expanded flowers of Magnolia feeding on the sweet juices and pollen.[2] Carrion beetles are found in the spathes of the aroids. The interior of flowers is also used for nocturnal lodging, the temperature prevailing within being several degrees warmer than that of the outer atmosphere.

Color and odor are of little significance as allurements to the anthophilous Coleoptera, for although beetles are most frequently found on yellow and white flowers this is not an evidence of "a color preference," as Müller supposed, but is a result incidental to the flower characters previously described. Since, however, beetles are strongly attracted by a bright light it is not unlikely that a sharp contrast in luminosity between the inflorescence and the foliage is noticed by them. It has been frequently asserted that floral odors are very attractive to beetles, but we have met little evidence to support this view, although carrion beetles detect indoloid scents. The writer has exposed free honey for long intervals which attracted Hymenoptera, Diptera and Lepidoptera, but never any Coleoptera. But environment may be an important factor in determining the presence of certain genera. Banks observed that "at a patch near woodlands where there were many dead trees, a considerable variety of Longicorns were always obtainable; at another patch in an open meadow few Longicorns were ever found."[1] The writer has also noticed that while the Cerambycidæ were common on the flowers of Aralia hispida and Spiræa salicifolia in the open woodlands, they were entirely absent in the pastures. Many genera and species of this family follow in their distribution the coniferous forests of the north.[2] The season of the year is likewise important as fewer beetles are on the wing in September and October than in June and July.[3] Finally, if the larvæ live on the vegetative organs of a plant the adult beetles may be expected to visit the flowers.

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[1] Knuth, Paul, "Handbuch der Blütenbiologie," Vol. 1, p. 223.

[2] Kerner, A., "The Natural History of Plants," Vol. 2, p. 163.

Very few species of the Coleoptera have been recorded as anthophilous compared with the total number described. In all of the families, in most of the genera and in very many species in which anthophily occurs this habit has been acquired independently; but in the case of Gnathium and Nemognatha it probably arose before these genera were differentiated. Except in these two genera and to a less extent in Chauliognathus and the Lepturini the modifications induced are obscure and indistinct, from which it may be inferred that anthophily among the Coleoptera is of comparatively recent origin. The primitive Coleoptera lived largely upon the ground and were carnivorous, but as they learned to search for their prey on plants and to feed on vegetation anthophily became correspondingly more common. As pollinators of flowers the anthophilous beetles are of little significance. The enormous devastation of the vegetative organs of plants by beetles both in the larval and adult stages, the consumption and waste of the pollen and nectar, the destruction of the petals and other floral members, the absence of hair for holding pollen, the inactivity of many species and their indefinite manner of flight are factors which greatly reduce their value as pollen carriers. Floral structure shows absolutely no response to the visits of beetles, and there is no reason to suppose that the development of the entomophilous flora would have varied in any respect had entomophily never arisen among the Coleoptera.

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[1] Banks, N., "At the Ceanothus in Virginia," Ent. News, Vol. 23, p. 102. Cf. also Hopping, R., "Some Notes on Coleoptera Found on Species of Ceanothus," Ent. News, Vol. 10, pp. 162–165.

[2] Wickham, H. F., "A List of the Coleoptera from the Southern Shore of Lake Superior," Proc. Davenport Acad. Nat. Sci., Iowa, Vol. 6, p. 127.

[3] Loew, E., "Der Blumenbesuch der Insekten im Wechsel der Jahrzeit," Bot. Vereins der Provinz Brandenburg, Vol. 47, p. 25.

TABLE OF NORTH AMERICAN SPECIES OF THE DIPTEROUS GENUS THRYPTICUS, WITH DESCRIPTIONS OF FOUR NEW SPECIES.

By Millard C. Van Duzee,
Buffalo, New York.

While studying the Thrypticus in my collection and a little material that came to hand I found four forms that seem to be new. These are described below.

In *willistoni* Wh. the fore and middle coxæ may be mostly yellow or infuscated almost to the tips, while in the female they may be somewhat blackened. This seems to be our most abundant species in western New York. I have seen examples from New England; Toronto, Ont.; and Columbia, Mo. I have taken a number of *T. fraterculus* Wh. at Lewiston, N. Y., and have seen a series of eight from Berkeley Hills, Cal.; Professor Aldrich reports it from Mexico.

The species of Thrypticus are minute flies of bright metallic color with a concave area in front of the scutellum and with the bristles and hairs of the thorax and abdomen yellow; the third and fourth longitudinal veins are usually convergent at tip, but sometimes parallel, and the hypopygium is flexed under the abdomen, often reaching nearly to the thorax.

The hypopygia of the males of those species I have examined are very similar. There is a large capsule or outer part which is covered with scales of pollen that are always inclined backward. Its appendages are lamelliform with a pair of slender processes at their base in most species (these seem to be lacking in *willistoni*). There is also a central filament (the penis) which originates on or near the base of the hypopygium and usually extends nearly to the end of the lamellæ; this filament is inclosed in a sheath which is shorter and often so closely applied to it that the two appear to form one piece. In the drawing of *aurinotatus* sp. nov. this filament does not show as it was folded under the abdomen.

Most of the species of this genus are difficult to separate except by the hypopygium and its appendages, and great care should be taken to place the specimen so as to get a direct side view of these organs, or the perspective will give a very wrong idea of their form.

In mounting them it is always best to extend the hypopygium, which can be done easily with a pin.

Some allowance must be made for shrinkage and also for variation in color, but I do not think the variation is great. This paper is based on the study of about fifty specimens.

TABLE OF NORTH AMERICAN SPECIES.

1. Femora green (Fig. 2) .... *fraterculus* Wh.
   Femora yellow 2
2. Venter and part of the dorsum of the abdomen yellow 3
   Abdomen without yellow except sometimes on the venter 4
3. Venter, whole of sixth abdominal segment, antennæ and base of hypopygium yellow (Fig. 8) .... *cupuliferus* Ald.
   Venter, first two abdominal segments, antennæ and base of hypopygium yellow (Fig. 1) .... *abdominalis* Say.
4. Hypopygium ovipositor-like, bent under the abdomen .... *singularis* Ald.
   Hypopygium normal 5
5. Fourth vein bent backward to meet the cross-vein, forming a distinct angle at this point .... *minor* Ald.
   Fourth vein only gently bent at the cross-vein 6
6. Antennæ yellow 7
   Antennæ black 8
7. Capsule of hypopygium truncate at tip (Fig. 3) .... *vietus* n. sp.
   Capsule pointed at tip (Fig. 5) .... *muhlenbergiæ* J. & C.
8. Hypopygial lamella sessile, rounded at tip (Fig. 9) .... *tectus* sp. nov.
   Lamella somewhat petiolate 9
9. Lamella nearly round (Fig. 6) .... *willistoni* Wh.
   Lamella large, somewhat oval, about twice as long as wide 10
10. Thorax green with violet reflections and a golden spot before the scutellum (Fig. 4) .... *aurinotatus* sp. nov.
    Thorax green or purple with the posterior depression green 11
11. Thoracic dorsum purple, hypopygium rather pointed, lamella pointed .... *pusillus* Ald.
    Dorsum of thorax green, hypopygium rounded at tip (Fig. 7) .. *comosus* sp. nov.

Thrypticus abdominalis Say.

Chrysotus abdominalis Say., Jour. Acad. Sci. Philadelphia, VI, p. 169.

Male: Length 2 mm. Eyes nearly touching below the antennæ; face green (purple in one specimen); front purple; mouth parts yellow or yellowish brown; antennæ and arista yellowish brown; bristles of the head and thorax yellowish. Thorax green, sometimes with coppery reflections on the posterior part, in one specimen with purple reflections on the anterior part; pleuræ green with the posterior edge yellow. Abdomen bright green with the first two segments almost entirely yellow; venter yellow; hypopygium (Fig. 1) brown with the base yellowish; its appendages yellow, the lamella with mixed yellow and black hairs. Coxæ and feet pale yellow with yellow hairs. Tegulæ, their cilia and the halters yellow. Wings hyaline, slightly tinged with gray; veins yellowish.

Redescribed from four males: one in the Cornell University collection, taken about the first of June at Columbus, Mo., by C. R. Crosby; one in the collection of C. W. Johnson and taken at Hot Springs, N. C., and two from Opelousas, La., in April.

In the drawing the central filament is separated from its sheath and bent upwards, usually it is carried in its sheath and they appear to form one piece.

Thrypticus vietus sp. nov.

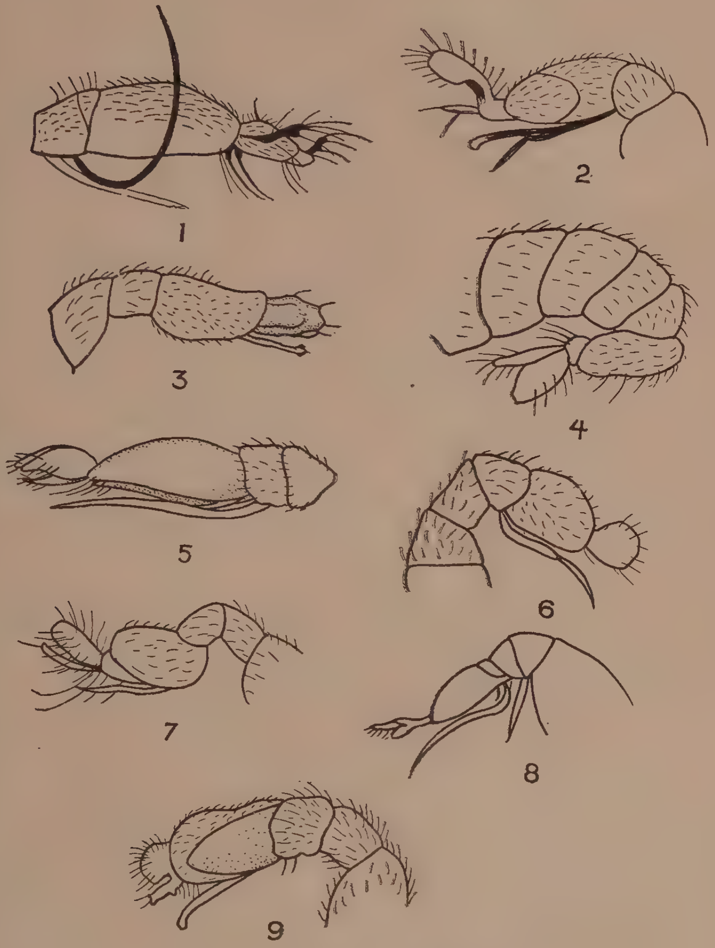
Male: Length 2 mm. Eyes contiguous (or seem to be, the head is shrunken); front green; palpi yellow; antennæ yellow, darker at tip; bristles of the head and the arista yellowish, but brown in certain lights. Thorax bright but dark green; abdomen dark metallic green with slight violet reflections toward the base; hairs and bristles of the thorax and abdomen yellow; hypopygium (Fig. 3) brown with yellow appendages; lamella oval, rather large; filament black with yellow tip which is a little spear-shaped. Fore coxæ yellow; middle and hind coxæ black with yellow tips; femora, tibiæ and tarsi pale yellow, their hairs mostly yellowish. Tegulæ, their cilia and the halters yellow. Wings grayish hyaline; veins brown; third and fourth veins parallel.

Female: Ovipositor minute, reddish yellow; tip of the abdomen and the base of the segments reddish coppery; face bluish green.

Described from one male and one female which I took at Bradentown, Fla., March. Type in the author's collection.

Thrypticus comosus sp. nov.

Male: Length 1.75 mm. Face dark green, shining, wide at the antennæ but the eyes almost meeting at the oral margin; mouth parts yellowish; Front dark green, ocellar bristles brownish yellow; antennæ dull black, small. Thorax and abdomen dark green, very shining, the former with slight golden reflections; bristles of the thorax and abdomen yellowish; hypopygium black, shining, its appendages yellow; (Fig. 7); lamella large with minute pubescence and several bristly hairs on the surface, behind the lamella there is a slender bristly appendage and back of this two long slender hairs, which are nearly as long as the hypopygium; filament dark yellow. Fore coxæ yellow; middle and hind coxæ black with greenish reflections and yellowish tips; femora, tibiæ and tarsi pale yellow; last joint of the middle and last two joints of the fore tarsi blackish. Tegulæ, their cilia and the halters yellowish. Wings hyaline; veins brown; venation as in *willistoni.*



EXPLANATION OF PLATE 7.

Hypopygia of Thrypticus. Fig. 1, *T. abdominalis* Say; fig. 2, *T. fraterculus* Wheeler; fig. 3, *T. vietus* sp. nov.; fig. 4, *T. aurinotatus* sp. nov.; fig. 5, *T. muhlenbergiæ* J. & C.; fig. 6, *T. willistoni* Wheeler; fig. 7, *T. comosus* sp. nov.; fig. 8, *T. cupuliferus* Aldrich; fig. 9, *T. tectus* sp. nov.

In the drawings, the scales of pollen appear as hairs inclining backward, there are no real hairs on the capsules of any of the hypopygia that I have examined.

Described from two males, one taken at Ellis, N. Y., on June 13; and one at Toronto, Ont., July 4. Type in the Cornell University collection.

This species differs from others in having two long slender hairs near the base of the hypopygial lamella, and in the form of the hypopygium. It comes near *aurinotatus* sp. nov. in the form of the hypopygium and its appendages.

Thryticus tectus sp. nov.

Male: Length 2 mm. Face bright green, narrow; mouth parts black; front violet, shining; frontal bristles black; antennæ small black; arista dark brown, pubescent. Thorax and abdomen bright green with yellow hairs and bristles which appear dark brown when viewed from the side; hypopygium black, only a little shining, its appendages short and yellow, lamella rounded at tip (Fig. 9). Fore coxæ and legs pale yellow, tarsi scarcely infuscated at tips; middle and hind coxæ infuscated almost to the tips; fore coxæ slightly darkened on the front surface; hind coxæ with a slender bristle on the outer side. Halters yellow. Wings with the venation typical of the genus; tinged with gray; veins brown.

Described from one male taken at East Aurora, Erie County, N. Y., July 12. Type in the author's collection.

This comes so near *willistoni* Wh. that it was with some hesitation that I separated it. It looks like that species with the lamellæ half concealed, but it also has the appendages at their base well developed, these appendages are not found in *willistoni*, the lamella is also more hairy.

Thripticus aurinotatus sp. nov.

Male: Length 1.25 mm. Face narrow; front black (opaque in type specimen); antennæ and arista brown, densely covered with pale pubescence, the former with the third joint somewhat rounded at tip. Thorax dark green, appearing dark violet when viewed from the front; depressed portion before the scutellum very conspicuous, being deep, well defined and of a golden color when seen from behind. Abdomen dark green; all the hairs and bristles of the thorax and abdomen yellow; hypopygium (Fig. 4) black, appendages pale yellow, lamella large and rather pointed, the inner appendages are also larger than in most species and as long as the lamella. Tegulæ, their cilia and the halters pale yellow. Coxæ and legs pale yellow with the hairs mostly yellow. Wings grayish hyaline, veins yellowish brown, becoming yellow at the root of the wing; venation about as in *T. willistoni* Wh.

Described from one male from Billy's Island, Okefenokee Swamp, Ga. Taken by Dr. J. C. Bradley in June. Type in the Cornell University collection.

This species is related to *willistoni* Wh. and *vietus* sp. nov. but differs much in general color, and in the form of the hypopygium and its appendages. It also differs from *vietus* in having the antennæ brown, not yellow as in that species.

SYSTEMATIC PAPERS ON NEW ENGLAND HEMIPTERA.[1]

By H. M. Parshley.

With Plates VI and VII.

I. Synopsis of the Families.

The tables to be published under the above title form a part of a general account of the Hemiptera [2] of New England on which I am engaged, but as an early appearance of the whole is not to be expected, it seems desirable that the more generally useful parts be made immediately available.

There are to be found in various publications a number of keys to the families of Hemiptera, but for one reason or another they do not enable those who are unfamiliar with the group to place specimens with certainty in their proper families. Some are inaccurate, some incomplete, while those which are free from these faults are very difficult to work because they generally lack figures and employ obscure characters, the latter often necessary in a table which aims at universality or natural arrangement. It seems to me that these difficulties can be avoided by limiting the application of the key to the fauna of a restricted region,[3] sacrificing natural arrangement in favor of clearness, and illustrating structures of importance. The synopses in this series are offered as an attempt in that direction.

In preparing the tables I have made free use of the writings of previous authors, but all the work has been done with continual reference to the specimens themselves, more particularly of the species occurring in New England, of which I have before me a fairly complete collection. Thus the characters proposed by others have been examined with regard to their applicability to our species, and not a few have been found to be decidedly misleading when presented without qualification. Groups not known to me to occur in this region are marked with an asterisk, and those of which I have not as yet seen specimens are indicated by a dagger. I hope that anyone who may know of New England records for the forms so marked will communicate with me on the subject.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 91.

[2] Considered as an order distinct from the Homoptera.

[3] Thus permitting in some cases the use of easily observable characters not common to all members of the family in question.

The characters which are of distinctive importance are given first in the dichotomies. Those which follow have been added to assist in determination, and they are not necessarily peculiar to the group in question, except such as are strictly alternative. To the short descriptions of the families should be added the characters already used in the appropriate divisions of the key. In studying the smaller forms a binocular or ordinary compound microscope will be found almost indispensable.[1]

There is difference of opinion among authorities regarding the names which should be used for certain families, and in such cases I have given both terms. The cause of this disagreement lies in the fact that the present rules of nomenclature may be interpreted in more than one way. There seems to be a growing sentiment among zoölogists in favor of establishing a list of names not subject to change, and if this action is taken by the International Congress it may be that those of the more familiar names which are now held by some to be invalid will regain their standing.[2]

DESCRIPTIVE SYNOPSIS OF THE FAMILIES.[3]

1. Antennæ shorter than the head, generally concealed in cavities between head and thorax; metasternal orifices absent 2
    Antennæ as long as or longer than the head, exposed 8
2. Ocelli present; littoral; not over 10 mm. in length 3
    Ocelli absent; aquatic 4

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[1] Definitions of a number of hemipterological terms will be found in a paper on the squash-bug by Tower, Ann. Ent. Soc. Am., VI., 1913, p. 427; and in my paper on Miridæ, Ent. News, XXVI., 1915, p. 208. In connection with the latter should be mentioned an additional reference on the Mirid "anal" vein; Reuter, Bemerk., Oef. Fin. Vet. Soc. Förh., LIV., 1911–12, p. 19.

[2] It should be noted that as a result of more or less recent nomenclatorial changes, the species represented by certain figures on the plates would be otherwise named by some authorities, as follows: fig. 1, *C. lintneriana;* fig. 3, *Saldula pallipes;* fig. 8, *Hebrus burmeisteri;* fig. 11, *Nabis pallescens;* fig. 13, *Phymata erosa wolffi;* fig. 22, same as fig. 8.

I am indebted to Mr. E. P. Van Duzee for his kindness in giving me advance information in regard to his list of Hemiptera, which is soon to be published.

[3] This table is adapted for the determination of adults only; and mature forms which are brachypterous or wingless must in some cases be treated with caution.

3. Antennæ exposed; front legs similar to intermediate; rostrum 4-segmented, first segment short; front and intermediate tarsi 1-segmented (?), hind 2-segmented; predatory . . . . **OCHTERIDÆ**

   Antennæ concealed; front legs raptorial; rostrum short, 4-segmented; front and intermediate tarsi 1-segmented, hind 2-segmented; eyes very protuberant; short, stout, roughened forms; predatory
   *__MONONYCHIDÆ__ or **NERTHRIDÆ**

4. Hind tarsi without two distinct claws (except *Plea* which is less than 3 mm. in length); front legs not raptorial in structure; moderate or small in size. . 5

   Hind tarsi with claws; front legs raptorial. 6

5. Head overlapping thorax dorsally; body flattened above; rostrum short, hidden under a broad flat transversely striated plate (epistoma); front tarsi- 1-segmented, palæform (fig. 28); male genitalia asymmetrical; predatory; swim with dorsal side uppermost. . . . . **CORIXIDÆ**

   Head inserted in thorax; body convex above; rostrum free, 3- or 4-segmented; tarsi 2-segmented (front tarsi of the male sometimes 1-segmented); predatory; swim with ventral side uppermost. . . . . **NOTONECTIDÆ**

6. Membrane reticulately veined; large in size. 7

   Membrane without veins; rostrum 3-segmented; front tarsi 1-segmented, intermediate and hind 2-segmented; hind legs not natatorial; predatory; moderate in size . . . . **NAUCORIDÆ**

7. Apical appendages of abdomen long and slender, not retractile; hind legs not much flattened; rostrum 3-segmented; tarsi 1-segmented; hind coxæ rotatory; predatory . . . . **NEPIDÆ**

   Apical appendages of abdomen short and flat, retractile; hind legs distinctly flattened, natatorial; rostrum 3-segmented; tarsi 2-segmented; hind coxæ hinged; predatory . . . . **BELOSTOMATIDÆ**

8. Head shorter than thorax including scutellum. 9

   Head as long as entire thorax, both elongated; ocelli absent; eyes distant from anterior margin of thorax; rostrum 3-segmented; tarsi 3-segmented; body and appendages slender; generally wingless; predatory; aquatic, living on the surface near shore; length about 10 mm. . . . . **HYDROMETRIDÆ**

9. Claws of at least the front tarsi distinctly anteapical with terminal tarsal segment more or less cleft (fig. 12); aquatic, living on the surface 10

   Claws all apical, last tarsal segment entire; aquatic and terrestrial forms. . . 11

10. Hind femora extending much beyond apex of abdomen; intermediate and hind pairs of legs approximated, very distant from front pair; ocelli present, but sometimes very obscure; eyes close to anterior margin of prothorax (fig. 29); rostrum 4-segmented, first and second segments short (fig. 29); tarsi 2-segmented; parts of hemielytra more or less confluent (fig. 16); often wingless; predatory; moderate in size. . . . . **GERRIDÆ**

    Hind femora not extending much beyond apex of abdomen; intermediate pair of legs about equidistant from front and hind pairs (except in *Rhagovelia*); ocelli obsolete or absent; rostrum 3-segmented; front tarsi 1- or 2-segmented, intermediate and hind 2- or 3-segmented; predatory; usually live on surface, but some species can dive; moderate or minute in size. . . . . **VELIIDÆ**

11. Antennæ 5-segmented...12
Antennæ 4-segmented, disregarding minute ring-segments; (antenniferous tubercles of head should not be mistaken for segments, figs. 11, 30)......13

12. First and second segments of antennæ thicker than the others (fig. 8); clavus similar in texture to the membrane which is without veins (fig. 22); head and thorax sulcate beneath; rostrum 3-segmented; tarsi 2-segmented; aquatic, living on the surface; minute in size..... **HEBRIDÆ** or **NÆOGEIDÆ**
First segment of the antennæ thickened, second slender (fig. 1); margin of head carinate above insertion of antennæ; scutellum rather large, usually extending beyond middle of abdomen; terrestrial; moderate in size, rarely minute 32

13. Prosternum with a median longitudinal transversely striated or granulated stridulatory groove visible anterior to front coxæ, receiving the tip of the rostrum; rostrum 3-segmented, short and strong; length not less than 5 mm. 14
Prosternum without a stridulatory groove; size large or small..............15

14. Terminal segment of antennæ thickened; front legs highly modified, stout, raptorial (fig. 13); scutellum moderate in size; membrane with numerous veins; front tarsi small and retractile; tarsi 2-segmented; roughly sculptured predatory forms; moderate in size **PHYMATIDÆ** or **MACROCEPHALIDÆ**
Terminal segment of antennæ filiform (sometimes faintly divided into numerous small parts); front legs usually much like the others, though raptorial in function, sometimes somewhat thickened and spinous; scutellum small; membrane with few veins; tarsi 3-segmented; body robust or linear; usually predatory; large or small in size ....**REDUVIIDÆ**

15. Hemielytra closely reticulate in relief, membranous between the reticulations, more or less lace-like in appearance (figs. 17, 18); size small..............16
Hemielytra not so reticulate, or absent; size large or small................17

16. Juga free, produced before apex of head, longer than tylus (fig. 14); hemielytra with a non-reticulate membrane, the rest reticulately punctate (fig. 18); ocelli present; rostrum 4-segmented; tarsi 2-segmented; one small species **PIESMIDÆ**
Juga not prominent, not longer than the tylus (fig. 15), head sometimes with dorsal anteriorly projecting spines; hemielytra of similar texture throughout, densely reticulate (fig. 17), membranous between the reticulations; ocelli absent; rostrum 4-segmented; tarsi 2-segmented; numerous small species **TINGITIDÆ**

17. Pronotum divided into three lobes; head contracted behind the eyes; hemielytra wholly membranous, with a few distinct longitudinal and cross veins; ocelli present; rostrum 3- or 4-segmented (?); front tarsi 1-segmented, intermediate and hind 2-segmented; predatory; fly in swarms; very minute and delicate forms[1]......................... ***HENICOCEPHALIDÆ**
Pronotum, head, and hemielytra otherwise constructed.................18

18. Rostrum really or apparently 3-segmented.............................19
Rostrum 4-segmented, first segment sometimes short (fig. 11)...........24

For figures see Johannsen, PSYCHE, XVI, 1909, pl. i.

19. Body convex below, flat or slightly concave above; greenish in color; clavus membranous, similar in texture to the membrane, the latter without veins (fig. 21), corium somewhat thickened; usually wingless; ocelli distinct in winged form, obsolescent in wingless form; rostrum 3-segmented; tarsi 3-segmented; small aquatic predatory species living generally on floating vegetation. .... MESOVELIIDÆ

Body usually very thin, flat above and below; when not distinctly flattened hemielytra are not constructed as above; color not greenish; terrestrial or riparian 20

20. Tarsi 2-segmented... 21

Tarsi 3-segmented...22

21. Head wider just behind the eyes than immediately in front of them; eyes not projecting beyond extreme side of head (fig. 9); trochanters distinct; abdominal spiracles midway between apex and base of ventral segments: ocelli absent; rostrum apparently 3-segmented; true first segment very small, often concealed; flat dark colored species living under dead bark; moderate in size .... DYSODIIDÆ

Head narrowed behind the eyes, eyes projecting strongly (fig. 10); trochanters connate with femora; abdominal spiracles near base of segments; other characters as in the preceding family.......................... ARADIDÆ

22. Ocelli present 23

Ocelli absent; hemielytra always much reduced, without membrane; rostrum not reaching intermediate coxæ, 3-segmented; tarsi 3-segmented; parasitic on vertebrates; rather small species.......CLINOCORIDÆ or CIMICIDÆ

23. Hemielytra provided with a cuneus, membrane without long closed cells (fig. 2), sometimes without veins; occasionally brachypterous; head horizontal; rostrum 3-segmented; tarsi 3-segmented; small predatory forms ANTHOCORIDÆ

Hemielytra without a cuneus; membrane with four or five long closed cells (fig. 3); tylus separated from frons by an impressed line; always fully winged; predatory; littoral; moderate or small in size SALDIDÆ or ACANTHIIDÆ

24. Ocelli absent...25

Ocelli present 27

25. Membrane with two large cells at base from which extend about eight branching veins (fig. 4); hemielytra without a cuneus; rostrum 4-segmented; tarsi 3-segmented; phytophagous; rather large strong forms. *PYRRHOCORIDÆ

Membrane with one or two small cells at base, very rarely with longitudinal veins; cuneus distinct; rather small delicate forms....................26

26. First segment of rostrum longer than broad, extending generally somewhat beyond posterior margin of head; membrane with two small cells at base or rarely one (fig. 5); generally without longitudinal veins other than the "anal" vein; rostrum 4-segmented; tarsi 3-segmented; phytophagous, or rarely predatory; numerous common species...... CAPSIDÆ or MIRIDÆ

First segment of rostrum little or not longer than broad, extending posteriorly not farther than middle of eyes; membrane with one cell; rostrum 4-segmented; tarsi 3-segmented; very few rare species. †TERMATOPHYLIDÆ

27. Front legs raptorial, the tibiæ and usually the femora armed with rows of numerous closely set fine spines which interlock when the leg is flexed, front femora more or less thickened (fig. 23), the femoral spines sometimes replaced by closely set even setæ; rostrum 4-segmented, the first segment short (fig. 11); membrane with a few long cells from which radiate numerous veins; sometimes brachypterous; tarsi 3-segmented; wandering predatory species of moderate size . . . . **NABIDÆ**

Front legs not especially modified for grasping, generally much like the others, front femora sometimes thickened and armed with a few teeth; first segment of rostrum generally longer than wide 28

28. Body and appendages extremely slender, linear; antennæ geniculate, biclavate; eyes distant from base of head; ocelli present; rostrum 4-segmented; tarsi 3-segmented; inhabit underbrush; probably phytophagous; moderate in size . . . . **NEIDIDÆ**

Body and appendages not extremely slender, antennæ otherwise constructed 29

29. Membrane with five usually simple veins (fig. 6); antennæ inserted low on the side of the head, usually below or on a line drawn from the middle of the eye to the anterior end of the buccula (fig. 24); ocelli present; rostrum 4-segmented; tarsi 3-segmented; sometimes brachypterous; phytophagous; moderate or small in size . . . . **LYGAEIDÆ** or **MYODOCHIDÆ**

Membrane with numerous more or less anastomosing veins (fig. 7); antennæ inserted high, usually above such a line (figs. 25, 30) 30

30. Metasternal orifices generally obsolete, when present placed between intermediate and hind coxæ near median line, with two diverging furrows running outwards; ocelli present; rostrum 4-segmented; tarsi 3-segmented; phytophagous; colors for the most part light; moderate or small in size . . . **CORIZIDÆ**

Metasternal orifices distinct, placed farther outward; colors usually dark; generally over 10 mm. in length 31

31. Head much narrower and shorter than the pronotum (fig. 26); bucculæ extending posterior to insertion of antennæ (fig. 25); ocelli present; rostrum 4-segmented; tarsi 3-segmented; generally phytophagous; moderate or large in size . . . . **COREIDÆ**

Head much larger proportionally, the part between the eyes wider than the scutellum (fig. 27); bucculæ anterior to insertion of antennæ (fig. 30); ocelli present; rostrum 4-segmented; tarsi 3-segmented; form rather elongated; phytophagous (always?); moderate in size . . . . **ALYDIDÆ**

32. Scutellum generally moderate in size, more or less narrowed apically; scutellum rarely covering most of abdomen, in which case colors are bright and contrasting, or there is a prominent tooth just anterior to lateral angles of pronotum; tibiæ not strongly spinose but sometimes bear very small spines or a more or less hairlike vestiture which may have a spinose appearance; ocelli present; membrane with many veins (fig. 19); rostrum 4-segmented; tarsi 3-segmented; phytophagous or predatory; moderate in size
CIMICIDÆ or **PENTATOMIDÆ**

Scutellum generally large, covering almost the whole of abdomen, usually very convex; when scutellum is reduced in size and flattened, tibiæ are strongly spinose.. 33

33. Tibiæ thickly set with long strong dark colored spines; corium narrow, acute apically (fig. 20); ocelli present; rostrum 4-segmented; tarsi 3-segmented; phytophagous (always?); generally shining black or blue, sometimes with lighter peripheral markings; rarely brownish in color, in which case length is less than 5 mm.; moderate to minute in size CYDNIDÆ or THYREOCORIDÆ

Tibiæ not strongly spinose; corium broad, obtuse at apex; ocelli present; rostrum 4-segmented; tarsi 3-segmented; phytophagous; gray, brown or reddish species; moderate in size...................... SCUTELLERIDÆ

NEW AMERICAN SPECIES OF ASTEIA AND SIGALSOËSA.[1]

By J. M. Aldrich,

Assistant in Cereal and Forage Crop Insect Investigations,
U. S. Bureau of Entomology.

The two genera named are readily distinguished from other Drosophilidæ by the shortness of the second longitudinal vein, which surpasses the first but slightly, as the accompanying sketches show. Asteia has been known from the time of Meigen as a European genus, of which four species are recorded in the Palæarctic Catalogue; it has no posterior cross-vein, and the arista is plumose as in Drosophila. Sigaloëssa was established by Loew for a Cuban species *S. bicolor* (Centuries, VI, 100, 1865); it has a posterior cross-vein, and the arista is only microscopically pubescent in most cases, although in *frontalis* described below it is short-plumose.

The wing figured by Williston, Manual, 1908, p. 300, fig. 7, as a doubtful member of Sigaloëssa, belongs to a fly of another genus; his figure on page 311, fig. 7, is correctly named as a Sigaloëssa.

The *Asteia tenuis* of Walker, Trans. Ent. Soc., n. ser., V, 331, must belong somewhere else; he mentions the posterior cross-vein, which being near the border would also exclude the fly from Sigaloëssa. Walker himself gave the genus with a question, but Osten-Sacken dropped the interrogation point, perhaps only a clerical error.

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[1] Published by permission of the Chief of the Bureau.

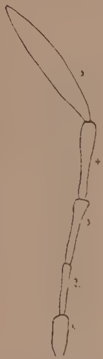


Fig. 1. Antenna of Cosmopepla carnifex Pentatomidae

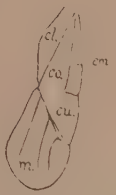


Fig. 2. Hemielytron of Anthocoris musculus Anthocoridae

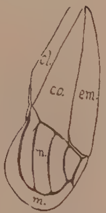


Fig. 3. Hemielytron of Acanthia pallipes Acanthiidae

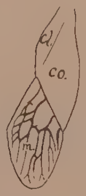


Fig. 4. Hemielytron of Largus succinctus Pyrrhocoridae

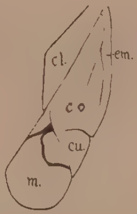


Fig. 5 Hemielytron of Monalocoris filicis Miridae

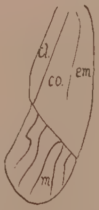


Fig. 6. Hemielytron of Emblethis vicarius Myodochidae

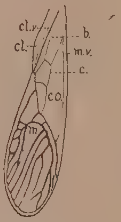


Fig 7. Hemielytron of Protenor belfragei Alydidae

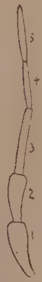


Fig. 8. Antenna of Naeogeus burmeisteri Naeogeidae

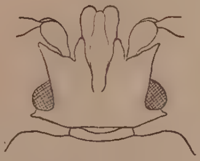


Fig. 9. Head of Neuroctenus simplex Dysodiidae

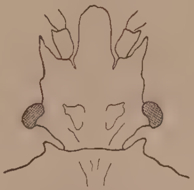


Fig. 10. Head of Aradus quadrilineatus Aradidae

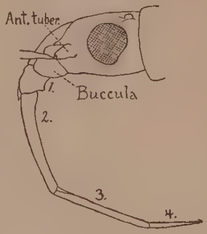


Fig. 11. Head of Reduviolus pallescens Nabidae

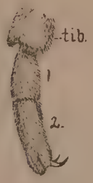


Fig. 12. Front tarsus of Gerris marginatus Gerridae

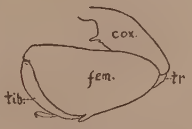


Fig. 13. Front leg of Phymata fasciata Macrocephalidae

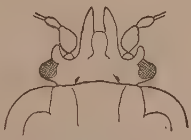


Fig. 14. Head of Piesma cinerea Piesmidae

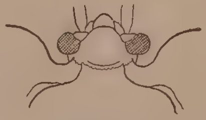


Fig. 15. Head of Corythuca arcuata Tingitidae

PARSHLEY—*New England Hemiptera.*

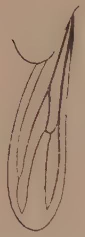


Fig. 16. Hemielytron of Gerris buenoi Gerridae

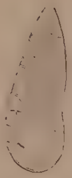


Fig. 17. Hemielytron of Leptostyla oblonga Tingitidae

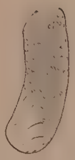


Fig. 18. Hemielytron of Piesma cinerea Piesmidae

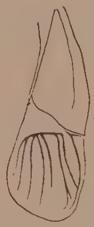


Fig. 19. Hemielytron of Mormidea lugens Pentatomidae

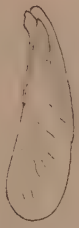


Fig. 20. Hemielytron of Thyreocoris unicolor Thyreocoridae

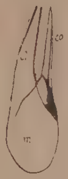


Fig. 21. Hemielytron of Mesovelia bisignata Mesoveliidae

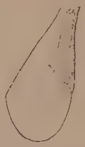


Fig. 22. Hemielytron of Naeogeus burmeisteri Naeogeidae

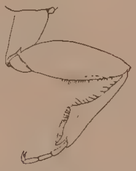
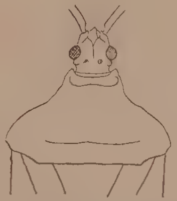
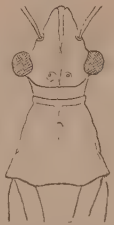


Fig. 23. Front leg of Pagasa fusca Nabidae





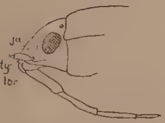


Fig. 24 Head of Emblethis vicarius Myodochidae

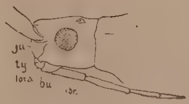


Fig. 25. Head of Chariesterus antennator Coreidae

Fig. 26. Head and thorax of Anasa repetita Coreidae

Fig. 27. Head and thorax of Alydus pilosulus Alydidae

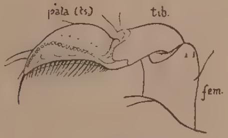


Fig. 28. Front leg of Arctocorisa interrupta Corixidae

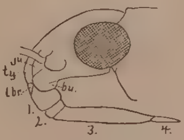


Fig. 29. Head of Gerris buenoi Gerridae

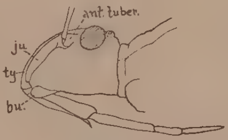


Fig. 30. Head of Alydus pilosulus Alydidae

19HPs

PARSHLEY—*New England Hemiptera.*

Types of new species are in the author's collection except where otherwise indicated.

A specimen of *Sigaloëssa flaveola* Coq. is in the author's collection, taken at Lawrence, Kans. The only other described species, *bicolor* Loew, has not been seen.

Asteia is here recorded from North America for the first time.

Asteia beata sp. nov.

♀. Yellow, the front brown and mesonotum shining black; abdomen with five rows of conspicuous black dots.

Front wider than one eye, brown above, gradually yellowish below; two pairs of small verticals, one frontal on each side close to eye and above middle of front, reclinate; ocellars minute; antennæ short, thick, yellow, a rather long erect hair on second joint; arista with about 7 alternating rays, jointed zigzag between them; face wide, short, mostly taken up with a silver crossband, which is very narrowly margined with black above and below; vibrissæ small but distinct; proboscis and palpi yellow, the epistoma with a sharp rim extending down to enclose these when retracted; lower part of occiput yellow.

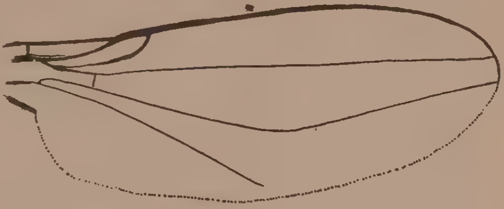


Fig. 1. *Asteia beata* sp. nov., wing.

Mesonotum shining black, narrowly yellowish behind. 2 psdc, 1 npl, 2 yellow stpl, 1 pair scutellars, and apparently no other thoracic bristles; pleuræ yellow from the npl suture down, with a black spot on sternopleura and another behind it; scutellum pure yellow, somewhat swollen, with one pair of divergent, ascending bristles; metanotum yellow above, blackish below; halteres yellow, the knob elongated, black on outer side.

Abdomen yellow, soft and shriveled, with conspicuous deep black dots on the hind edges of the segments as follows: a median row of three, a lateral row of five, and a sublateral row (below the lateral) of four, each row beginning with the first segment.

Legs yellow, slender.

Wings hyaline, venation as figured.

Length, 2.4 mm.; of wing, 2.8 mm.

A single female, Chester, Mass., August 6, 1914, collected by C. W. Johnson, to whom it has been returned. A label bears the note, "Eyes green."

Asteia albovaria sp. nov.

♂. Shining brownish-black, abdomen largely yellow, legs yellow; a band on face, upper part of pleuræ, and scutellum, pure white.

Front about as wide as one eye, shining blackish to the anterior edge; antennæ brown, the lower edge of the third joint yellow; arista zigzag, with about 6 rays;

face yellow immediately below the antennæ, then with a narrow black band, below which is a wider pure-white band, below this again black, which extends to the bucca in less intensity; two small pairs of verticals; one of frontals, close to orbit and above middle of front; ocellars minute; vibrissæ distinct.

Mesonotum shining brownish-black; pleuræ with wide white stripe on upper part, a black one below this, and the lowest part yellow; scutellum pure-white, somewhat swollen, with one pair of divergent, ascending bristles; the remainder of the thoracic chætotaxy cannot be distinguished in the specimen, and the halteres are wanting.

Abdomen yellow with black bands, but not in condition to describe more fully.

Legs yellow, slender.

Wings hyaline, venation as in *beata*.

Length, 1.2 mm.; of wing, 1.6 mm.

One male, Peru, 1914, collected by H. A. Parish.

TABLE OF SPECIES OF SIGALOËSSA.

Mesonotum yellowish-red (D. C., N. H., Fla., Kans.)........... *flaveola* Coq.
Mesonotum shining black:
  Mesopleura with black stripe close up against notopleural suture (Potlatch, Ida.).. *lineata* sp. nov.
  Mesopleura with black stripe on lower edge:
    Front with two narrow silvery stripes on upper half (Peru).... *frontalis* sp. nov.
    Front without such stripes (Cuba, Porto Rico)............. *bicolor* Lw.
  Mesopleura without stripe (Potlatch, Ida.).................. *hirta* sp. nov.

Sigaloëssa lineata sp. nov.

♂. Front wider than one eye, brown above, gradually yellower forward, with a large indistinct yellow crescent above the antennæ (not the true lunule, but above it); antennæ small, brownish-yellow, partly concealed by the overhang of the front; third joint rounded, arista black with microscopic pubescence; face wide, rather excavated under the antennæ, lower part white with a narrow jet-black band along edge of mouth; palpi, proboscis and bucca yellow, the same color continuing up the posterior orbits; a few hairs on sides of epistoma, but no distinct vibrissæ; ocellar triangle blackish with almost imperceptible bristles; two pairs of verticals, the inner smaller; front with minute scattered hairs.

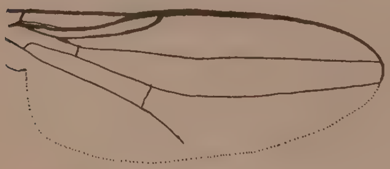


Fig. 2. *Sigaloëssa lineata*, sp. nov., wing of male.

Mesonotum shining black, yellow all round the edge except in front, between the humeri; pleuræ yellow, a black stripe just below the notopleural suture, a spot on sternopleura and another behind it; scutellum yellow; metanotum yellow above, black below; halteres yellow with a black knob. Dorsocentrals two, with a row of fine hairs extending forward from them; acrostichals also in the form of a single row of minute hairs; notopleurals 2; scutellars two pairs, the inner larger; post-alar 1; intra-alar 1 small behind; sternopleural 2.

Abdomen (shriveled) black with yellow markings, of which the most evident are on the first and fourth segments, in the form of more or less distinct crossbands; fifth segment shining black.

Legs pale yellow, slender.

Wings hyaline, venation as figured.

Length, 1.6 mm.; of wing, 2.4 mm.

♀. Face even more excavated, yellow with black mouth margin; segments 1, 2 and 3 of abdomen broadly black above, the rest whitish; hairs of abdomen quite long.

Length, 2 mm.; of wing, 2.8 mm.

One male, two females, collected on window in the large sawmill of the Potlatch Lumber Company at Potlatch, Latah County, Ida., on September 6, 1912.

Sigaloëssa hirta sp. nov.

♀. Yellow, the mesonotum except borders, the vertex and occiput, a spot on halteres, and a stripe on lower part of mesopleura, black.

Vertex including ocellar triangle black, front rather pure yellow, wider than one eye, covered with comparatively coarse black hairs; two small fronto-orbitals on each side high up, close to the orbit, leaning outward and a little backward; postverticals and ocellars distinct, the former divergent; two pairs of verticals of good size; antennæ partly concealed by the overhang of the front and the excavation of the face, moderately large, yellow, third joint round, brown on outer and apical part, arista long, with minute pubescence; face wide, entirely yellow; proboscis, palpi, bucca and posterior orbit yellow; the hind edge of bucca on each side bears half a dozen noticeable small bristles, from these a row of hairs extends forward ending in a distinct vibrissa.

Mesonotum shining black with a yellow lateral border including the humeri and extending to the corner of the scutellum; pleura yellow except the stripe noted above; scutellum yellow; metanotum dark brown; halteres yellow with large black spot on outer side of the knob; hairs and bristles quite strongly developed. There are two dorsocentrals on each side, with a row of strong hairs extending forward from them, acrostichals in a single row; notopleurals 2; post-alar 1; humeral 1 small; sternopleural 2; scutellars two pairs, the inner large and divergent.

Abdomen yellow, gradually blackish toward apex, extreme tip light yellow.

Legs yellow, slender.

Wings hyaline, venation as in *lineata*.

Length, 2.1 mm.; of wing, 2.6 mm.

Described from a single female, taken September 9, 1912, on a window in the sawmill at Potlatch, Ida., where I captured the type material of *lineata* and many other rare Diptera.

Sigaloëssa frontalis sp. nov.

♂. Front wider than one eye, shining black, a narrow silvery line on each side of the ocellar triangle, beginning at the declivity of the occiput and continuing straight forward half the length of front; anterior fourth of front yellow; compound eyes not limiting the vertex laterally, it being nearly twice as wide as the front and ending in a point each way; antennæ yellow, third joint brown on apical half or more, with upcurved short dense pale hair; arista black, short-plumose, with about a dozen rays; face concave, yellow, with slight whitish reflection; peristoma with a narrow shining black line almost in a horseshoe shape, between which and the eye the moderately wide bucca is pure silvery, which does not extend across the facial depression; proboscis and palpi yellow; a row of small hairs along the peristoma, the anterior one on each side forming a minute vibrissa. The chætotaxy of the front is not well preserved, but one vertical and one fronto-orbital can be seen, the latter close to the eye about the middle of the side.

Mesonotum shining black, the sides beginning with humeri yellow as far as the corners of the scutellum, which is also yellow; pleura yellow, a blackish shining stripe on lower part of mesopleura, a spot on sternopleura and one behind it; halteres yellow with large black knob. Bristles of thorax not very well preserved, but the following can be seen: 2 dc, 2 npl, 1 stpl, 1 post-alar, scutellar 1 pair and a small hair each side.

Legs yellow, slender.

Abdomen blackish above, yellow below.

Wings hyaline, venation as in *lineata*.

Length, 1.5 mm.; of wing, 1.8 mm.

A single male, collected in Peru in 1914 by H. S. Parish.

NEW SPECIES OF TACHINIDÆ (DIPTERA) FROM NEW ENGLAND.

By Harrison E. Smith,

U. S. Department of Agriculture, Bureau of Entomology, Cereal and Forage Insect Investigations.

Phasia (*Alophora*) **phasiatrata** sp. nov.

Black, densely brassy yellowish gray pollinose. Length 8.0 mm.

Frontal vitta as viewed from the side, velvety brownish black; as viewed from in front, yellowish gray pollinose. Ocellar triangle black, pollinose, the ocellar bristles distinct, proclinate. Sides of front yellowish gray pollinose, widely diverging below; at narrowest part less than one-third as wide as the frontal vitta. Frontal bristles in a single row, descending to base of the antennæ; outside of these sprinkled with black hairs. Orbital bristles absent. Antennæ black, pollinose, with a faint rufous tinge at apex of second and base of the third antennal joints. Third antennal joint less than two times as long as the second. Arista thickened on approximately the basal third, the penultimate joint as broad as long. Sub-crescent area of facial plate, immediately above base of antennæ, bright shining brownish black. Sides of face yellowish gray pollinose, a spot near the middle bordering the margin of facial plate, piceous. Cheeks one-third as wide as the eye height, bearing numerous long white hairs. Palpi yellow.

Thorax marked with four black vittæ, the two median vittæ fading out just posterior of the transverse suture. Dorso-central bristles, two, the anterior bristles short and weak. Sterno-pleura bearing one long bristle and numerous black hairs. Scutellum black, pollinose, bearing two pairs of marginal bristles. Legs yellowish, pollinose, tarsi black. Middle tibiæ each bearing a single short bristle, placed below the middle; the hind tibiæ pectinate with several bristles on the outer side.

Abdomen short, flattened, and nearly round. Shining black, segments two and three brassy pollinose on the basal two-thirds, the fourth segment wholly brassy pollinose. A median black dorsal vitta on the first three segments. Numerous bristly black hairs of abdomen appressed. Genitalia awl-shaped, directed backwardly.

Wings hyaline, except the base, which is smoky tinged to a point slightly beyond tip of the auxiliary vein. Last section of the third longitudinal vein about one-fourth as long as the preceding section, bearing one or two bristles at its base. Tip of the first longitudinal vein ending beyond small cross-vein. Calypteres yellowish white.

Described from two female specimens; taken at Melrose Highlands, Mass., May 18, 1911, by the writer, and at Cohasset, Mass., June 30, 1914, by Mr. R. T. Webber.

Holotype in the U. S. National Museum, Cat. No. 19238.

Paratype in the collection of the Boston Society of Natural History.

Gonia distincta sp. nov.

Shining black, pollinose species. Length, 11–13 mm.

Front two and one-half times as wide as either eye, the sides as viewed from above, polished translucent yellow. Frontal bristles descending nearly to the base of the third antennal joint, outside of these irregularly placed long macrochætæ and short bristly hairs. Two pairs of orbital bristles. Frontal vitta opaque yellow, the ocellar triangle black. Ocellar bristles stout, reclinate. Facial depression, sides of face and cheeks rich golden yellowish gray pollinose. Sides of face bearing black bristly hairs and a row of four or five macrochætæ on the inner margin, close to facial ridge. Cheeks one-third as wide as the eye height, sprinkled with black hairs and a row of long macrochætæ on the anterior margins. Antennæ four-fifths as long as the face, the first two joints yellow; the third joint black with a rufous tinge at its base, at least two times as long as the second. Arista thickened to the tip, the penultimate joint five-sixths as long as the last. Vibrissae strong, cruciate, placed less than one-half the length of the second antennal joint above the front edge of the oral margin, two or three bristles above each. Palpi yellow.

Thorax black, pollinose, marked with four black vittæ. Four dorso-central and four sterno pleural macrochætæ. Scutellum yellowish on the apical four-fifths, bearing three pairs of long marginal macrochætæ, besides the short stout apical pair, which extend vertically or horizontally. Legs black, the front tarsi slightly dilated. Middle tibiæ each bearing three or more macrochætæ on the front side near the middle. Hind tibiæ sub-ciliate.

Abdomen shining bluish black, yellowish gray pollinose with several darker reflecting spots. Second abdominal segment bearing a median marginal pair of macrochætæ, the third a marginal row and the fourth segment a single sub-marginal row. Hairs of abdomen appressed.

Wings hyaline; base of wing, the costal, sub-costal and marginal cells tinged with yellow. Third longitudinal vein bristly at least one-half the distance from its base to the small cross-vein. Apical cell open, ending far before extreme wing tip. Small cross-vein before tip of the first longitudinal vein. The posterior end of hind cross-vein nearer to bend of the fourth longitudinal vein than to the small cross-vein. Calypteres whitish.

Described from three females. One female (Holotype) in the collection of the Boston Society of Natural History; taken by Mr. C. W. Johnson at Westport Factory, Mass., July 31, 1913. Two females (Paratypes) one in collection of the U. S. National Museum Cat. No. 19236, and one in the collection of the Connecticut Experiment Station, taken by Mr. B. H. Walden at New Haven, Conn., May 16, 1911.

Neophorichæta gen. nov.

Close to *Phorichæta*. Eyes bare. Sides of face bearing a row of strong proclinate bristles. Third antennal joint at its greatest width nearly one half as broad as long. Vibrissæ cruciate placed on the oral margin, a bristle immediately above each vibrissa nearly three-fifths as long as the vibrissæ. Head wider than the thorax, the horizontal diameter at vibrissæ shorter than at the base of the antennæ. Penultimate joint of arista at least two times as long as broad. Proboscis fleshy, much shorter than dorso-ventral diameter of the head. Sides of face at narrowest part not over one-fifth as wide as the median depression. Apical cell ending before wing tip, closed, petiolate, the petiole not as long as the small cross-vein. Costal spine prominent. Posterior end of hind cross-vein nearer to bend of the fourth longitudinal vein than to the small cross-vein.

Type of the genus.—*Neophorichæta johnsoni* sp. nov.

Neophorichæta johnsoni sp. nov.

Length, 7–8 mm. Front one and one-fifth times as wide as either eye. Frontal bristles of three or four pairs, strong, cruciate, widely separated, descending to base of the second antennal joint. Outside of these an orbital row of proclinate bristles and several fine black hairs. Posterior orbital bristle stout, directed outwardly. Frontal vitta black, densely grayish pollinose, wider than side of front. Ocellar triangle and sides of front black, grayish pollinose. Ocellar bristles proclinate. Sides of face black, gray pollinose, bearing a few bristly black hairs outside of the row of facial bristles. Antennæ inserted at a point above the middle of the eye, black pollinose; the third joint with a faint rufous tinge at its base, about four times as long as the second antennal joint. Arista thickened on its bassal two-fifths to one-half, the penultimate joint two times as long as broad. Cheeks shining black, pollinose, about one-third as wide as the eye height, bearing several long bristles near the center and scattering black bristly hairs. Palpi black.

Thorax shining black, grayish pollinose, with a bronzy tinge, marked with three black vittæ. Three dorso-central and three sterno-pleural macrochætæ. Scutellum black, bearing three pairs of marginal macrochætæ, the apical pair cruciate. Bristles of scutellar disk, erect.

Abdomen shining black, grayish pollinose on the basal margins of the three posterior segments. The second segment bearing a median discal and marginal pair of machrochætæ, the third a discal pair and marginal row, and the fourth bristly on its apical two-thirds. Bristly hairs of the abdomen appressed.

Wings hyaline, faintly tinged with brownish at the base and along the costa. Posterior cross-vein and the fourth longitudinal vein beyond the bend also faintly bordered with brownish. Third longitudinal vein bristly to the small cross-vein. Fourth longitudinal vein beyond the bend abruptly curved inwardly. Calypteres whitish.

Described from two male specimens taken by Mr. C. W. Johnson, in honor of whom this species is named.

One male (Holotype), N. E. Harbor, Me., July 26, 1909.

One male (Paratype), Machias, Me., July 19. Both specimens in the collection of the Boston Society of Natural History.

Neopales noctuiformis sp. nov.

Black, grayish pollinose. Length 6–8 mm.

Front about as wide as either eye. Eyes hairy. Frontal vitta opaque reddish black. Ocellar bristles strong, proclinate. Orbital bristles absent in the male. Sides of front black, grayish pollinose with a yellowish tinge. Frontal row of bristles descending to or slightly below the base of the third antennal joint; outside of these a row of shorter bristles [1] and irregularly placed, bristly black hairs. Sides of face densely gray pollinose, less than one-third as wide as the median depression. Facial ridges bristly on the lowest three-fifths. Antennæ black, the third joint three and one-half to five times as long as the second. Arista thickened on the basal two to three-fifths, the penultimate joint longer than broad. Cheeks one-fifth as wide as the eye height, bearing bristly black hairs and a row of stout bristles on the anterior margins. Vibrissæ placed on the oral margin. Palpi yellow or brownish.

Thorax black, grayish pollinose, marked with five rather indistinct vittæ. Four dorso-central and three [2] sterno-pleural macrochætæ. Legs black, knees rufous.

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[1] In the holotype the row of bristles on the front, outside of the frontal row, are very weak, more closely simulating bristly hairs; whereas, in the four paratype specimens this row of bristles is quite distinct and prominent. This slight variation is very probably due to the artificial conditions of rearing to which the holotype was subjected.

[2] The specimens from North Andover, Mass., and Sugar Island, Me., each have three sterno-pleural bristles on one side and four on the other.

Middle tibiæ each bearing two or more macrochætæ on the front side near the middle. Hind tibiæ sub-ciliate.

Abdomen black, the segments grayish pollinose on the basal four-fifths, with the exception of the first segment, which is destitute of pollen on the dorsum. A median black dorsal vitta. First and second segments bearing a pair of median marginal macrochætæ, the third a marginal row and the fourth bearing macrochætæ on its apical two-thirds. Hairs of abdomen sub-erect.

Wings hyaline. Apical cell open, ending before the wing tip. The third longitudinal vein bearing two or three bristles at its base. Calypteres whitish, faintly bordered with yellowish.

Puparium 7 mm. in length. The anal stigmata highly raised, sub-cylindrical, nearly .5 mm. long. Reticulations in three distinct half circular impressions with a small circular impression in the center.

Described from five male specimens.

One male (Holotype) in collection of the U. S. National Museum, Cat. No. 19237 reared from an unknown Noctuid larva taken at Revere, Mass., by Mr. J. V. Shaffner.

Three males (Paratypes) taken by Mr. C. W. Johnson at Sugar Island, Me., July 17, 1907, and Orrs Island, Me., July 21, 1907. In collection of the Boston Society of Natural History.

One male (Paratype) taken by writer at North Andover, Mass., July 16, 1911. In author's collection.

A NEW WINGLESS PHORID FLY FROM JAMAICA.

By Charles T. Brues,
Bussey Institution, Harvard University.

Chonocephalus jamaicensis sp. nov.

♀. Length, 1 mm. Brownish yellow; dorsal abdominal plates fuscous; legs brownish-yellow, lighter beyond the femora. Head very slightly wider than long, broadest at the eyes which are quite near the hind angles; the latter rectangular, rounded only at the extreme corner; from just in front of the eyes, the front is narrowed, the edge regularly concave to the fore margin which is strongly arcuate and about two-fifths as broad as the head behind; sides of head below antennal cavities sinuate, convex behind and somewhat concave in front, turning in toward the median line a little before the fore margin of the front; posterior margin of head straight. Surface of head above covered with small, sub-erect hairs, and with a large bristle at the side margin of the front just above the antenna, followed by a series of three smaller ones extending forward along the edge of the front; side of head just below antenna with a group of three rather large and a few small bristles; oral margin fringed on each side with five delicate, downwardly directed bristles; antennæ small, rounded, but distinctly angulate at the insertion of the arista which is very long and delicate, reaching to the base of the abdomen. Head, viewed from the side, twice as long as high, flat above and strongly curved downwards in front and backwards to the anterior angle of the antennal cavity; face obtusely produced forward and downward below the oral margin; margin of head below eyes horizontal. Eyes with 15–16 ommatidia. Palpi of moderate size, flattened; with five bristles below and several longer ones at apex. Thorax in dorsal view three times as broad as long on the sides; medially narrowed to half its length at the sides, both the anterior and posterior margins bisinuate; humeri distinctly marked off as rounded tubercles; clothed with sparse fine hairs like those on the head, but without bristles. Abdomen with six fully chitinized plates which fully cover its dorsal surface, except where the sutures extend between them as very narrow membranous bands; first plate nearly semicircular, with straight posterior edge; second to fifth subequal in length, the fourth broadest; along the posterior edge each plate has a black band which bears a series of from 15–20 pale circular dots from each of which arises a bristle about one fourth as long as the width of the plate. Sixth plate a little longer than the preceding, rounded behind, and with four fine bristles on its posterior margin; whole abdomen above, finely, sparsely hairy. Ovipositor more or less exserted, of the usual tubular, soft, fleshy type. Venter with only one plate, that of the sixth segment; this somewhat broader than long, straight in front and on the sides, but concave behind; posterior margin with four small equidistant bristles, one at each angle with a pair between. Legs stout, hairy, but without distinct bristles, except for a tuft of short ones at the tip of the anterior coxæ, a series of five or six on the outer edge of the middle coxæ and one at the tip of the hind coxæ; front tibiæ with one minute spur; middle ones with a larger one and hind ones with a pair of which one is very small.

Williamstown, Jamaica, B. W. I. Type No. 9033 in the Museum of Comparative Zoölogy. Described from specimens given me by Prof. Roland Thaxter.

This species is a close relative of the other forms of Chonocephalus which have already been made known from various parts of the world. This great similarity of the species is most remarkable when it is recalled that the others known from females are from such widely separated regions as the Bismark Archipelago, German East Africa, Sumatra, India, Mexico and Guatemala. On account of their close resemblance I have drawn up a table for their separation. It must be stated, however, that this is in part compiled from descriptions, as I have seen specimens of only three species.

KEY TO THE SPECIES OF CHONOCEPHALUS (FEMALES).

1. Dorsal abdominal plates of the first to fifth segments with a series of transparent dots along the posterior border from which arise the marginal bristles......2

Plates of abdominal segments uniformly pigmented, without transparent dots along their posterior margins.......................................5

2. Front almost twice as broad behind as long.......................................3

Front narrower in proportion to its length; three bristles on lateral margin of front above the antennal cavity.......................................3

3. Head viewed from the side twice as long as high...(Jamaica, B. W. I.)....... *jamaicensis* Brues.

Head viewed from the side only one-half longer than high. (Bismark Archipelago.).......................................*dorsalis* Wandolleck.

4. Thorax greatly constricted medially, its length at the sides over twice that at the middle. (Sumatra.)...........................*depressus* de Meijere.

Thorax less strongly constricted medially, much less than twice as long at the sides as at the middle. (German East Africa.).......*kiboshoënsis* Brues.

5. Lateral margin of front above antennal cavity with one or more bristles which are much larger than the sparse hairs covering the head.................6

Lateral margin of front without any bristles above the antennal cavity; fourth dorsal plate of abdomen much longer than the third. (Guatemala.)........ *buccata* Malloch.

6. Lateral margin of front with a single bristle above the antennal cavity. (Mexico.).......................................*mexicanus* Silvestri.

Lateral margin of front with three bristles above the antennal cavity. (India.) *fletcheri* Schmitz.

AN OBSERVATION ON THE BREEDING HABITS OF *STIGMUS CONESTOGORUM* ROHWER.

By C. H. Richardson,
New Brunswick, New Jersey.

In a number of galls of *Holcaspis globulus* gathered from white oaks on September 13, 1914, at New Brunswick, N. J., was one inhabited by the wasp, *Stigmus conestogorum*. The dried condition of the gall showed that it had been deserted by the original owners. The wasp had formed numerous passage-ways in the pith which terminated in oval-shaped chambers. These chambers were filled with green aphids upon which larvæ, presumably of this species, were feeding. Since the female wasp was captured in the nest, it is possible that the larvæ of this species are attended by the parent throughout their active feeding period.

Stigmus fraternus and other Pemphredonidæ are said to burrow in the dried pithy branches of various kinds of plants and to fill their nests with plant lice.[1] Perhaps S. *conestogorum* also normally makes its nest in such twigs and only occasionally accepts galls. In any case, it is not a far cry from pithy twigs to pithy cynipid galls.

This species is, I believe, here recorded for the first time from New Jersey. It was described from specimens obtained in Pennsylvania.[2] I am indebted to Mr. Rohwer for the identification of the New Jersey specimen.

NOTES ON THE OCCURRENCE OF SOME ECONOMIC INSECTS NOT HERETOFORE RECORDED FROM NEW JERSEY.

By Harry B. Weiss,
New Brunswick, New Jersey.

Gracilaria azaleæ Busck.

This species has been noted in several greenhouses in northern New Jersey. The small larvæ turn over the tips and edges of azalea leaves and feed therein causing them to turn black and die. Pupation takes place in a silken, whitish cocoon usually attached to the leaf near where the larva has been feeding. This insect has also been taken in the larval and pupal stages on azaleas imported into New Jersey from Belgium. As yet, it has not become a serious greenhouse pest, probably because azaleas as a rule are not carried over until the next season or grown by most florists. After being forced, practically all are sold and fresh ones imported the next year.

Kaliosysphinga ulmi Lund.

This saw-fly leaf miner was noted at Westfield, N. J., during the summer of 1914, doing noticeable but not serious damage to the foliage of elm trees. The mines were irregular and blotch like in appearance. In Smith's 1909 list, it is mentioned only as being sure to occur in New Jersey.

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[1] Comstock. Manual for the study of insects, ed. 1913, pp. 655–656.

[2] Rohwer, Proc. U. S. Nat. Mus., Vol. 40, 1911, pp. 557–558.

Coleophora limosipennella Dup.

This elm pest which is also recorded in Smith's 1909 list as being sure to occur in New Jersey was found definitely at Hackensack during the summer of 1914 feeding on elms. It is also known as the European elm case bearer, the larva living in a flattened case with serrated upper edge. The damage deing done, however, was not serious.

Monarthropalpus buxi Lab.

This leaf miner was reported during the summer of 1914 from a private estate in Peapack, N. J., where it was injuring a box hedge. The maggots mine the leaves and in bad infestations much of the foliage is lost. This pest is known to occur in Maryland and New York but has not heretofore been recorded from New Jersey.

Leucaspis bambusæ Kuwana.

During the summer of 1911, bamboo growing around the edges of a pond in a nursery at Riverton, N. J., was found to be badly infested by what was undoubtedly the above scale insect. The insects were so thick around the joints of the plants that they resembled patches of snow. In spite of their numbers, however, they did no appreciable damage. Mrs. Fernald, in her catalog of the Coccidæ of the World, gives the habitat of this scale as Japan and the infested plants in this case were originally imported from that country. Mr. E. R. Sasscer, to whom some of the insects were only recently sent, replied that while the lobes were somewhat worn he was of the opinion that it was *L. bambusæ*. Unfortunately this splendid infestation was practically wiped out by the bamboo being cut back on account of its ungainly size.

Merodon equestris L.

This species known as the Narcissus fly was found in the larval stage only, at Orange, N. J., during October, 1913. The party on whose place it was found destroyed all suspicious bulbs and the following spring, nothing could be found, Since that time, however, reports have been made from that vicinity mentioning a maggot found in iris roots which had been injured by *Macronoctua onusta* Grote and I am of the opinion that these may be larvæ of the Lunate onion fly, *Eumerus strigatus* Fallen, inasmuch as Dr. E. P. Felt has recorded this species as occurring under such conditions.

EXCHANGE COLUMN.

Will exchange insects of various orders for Parasitic Hymenoptera from any part of the world.—C. T. Brues, Bussey Institution, Forest Hills, Mass.

Wanted. Ants from all parts of the world.—W. M. Wheeler, Bussey Institution, Forest Hills, Mass.

I pay cash or give American and exotic insects in exchange for fertile eggs of Catocala spp., *living* Catocala ♀ ♀ (captured specimens only), hibernating pupæ and larvæ of any other group of Lepidoptera.—William Reiff, 366 Arborway, Jamaica Plain, Boston, Mass.

Florida insects of all orders, also Fish, Batrachians, Reptiles, Shells and Marine Invertebrates sold by A. G. Reynolds, Gulfport, Florida.

New England Orthoptera identified. I wish to examine adult Orthoptera of all families from all parts of New England. Material will be identified for the privilege of retaining desired examples, for which good exchanges will be given, subject to approval of owner.—A. P. Morse, Wellesley College, Wellesley, Mass.

The undersigned will greatly appreciate receiving records of New Jersey species not listed in Smith's Insects of New Jersey.—Harry B. Weiss, 272 Hale St., New Brunswick, N. J.

Offered for cash, but exchange preferred. Fitch and early Illinois reports; Insect Life; Harris's Insect; many others.—J. F. Hallinen, Cooperton, Okla.

Histeridæ. North American Histeridæ identified or unidentified, desired in exchange for beetles of other families. F. G. Carnochan, Bussey Institution, Forest Hills, Massachusetts.

Hemiptera-Heteroptera. I desire specimens of this group from all regions, especially New England. I will give in exchange species of this and other orders (except Lepidoptera), and will identify New England material. Correspondence desired.—H. M. Parshley, Bussey Institution, Forest Hills, Mass.

Wanted: Psyche, Vol. VIII, No. 265 (May, 1898); No. 267 (July, 1898); No. 268 (August, 1898); Vol. IX, No. 300 (April, 1901). Address, giving price, Librarian, Stanford University, Cal.

Sarcophagidæ from all parts of the world bought or exchanged according to arrangement. North American material determined.—R. R. Parker, Entomological Laboratory, Massachusetts Agricultural College, Amherst, Mass.

Wanted: Transactions American Entomological Soc., Vol. 4; Entomological News, Vol. 2, Nos. 6 and 10; Vol. 8, Nos. 1 and 6; Vol. 9, Nos. 1 and 2; Vol. 10, No. 10; Vol. 11, Nos. 1, 3 and 5. Will purchase at reasonable price.—Howard L. Clark, P. O. Box 1142, Providence, R. I.

Wanted: Insects of any order from ant nests, with specimens of the host ants, from any part of the world; also Cremastochilinæ of the world. Will give cash or Coleoptera, Hymenoptera and Diptera from the United States.—Wm. M. Mann, Bussey Institution, Forest Hills, Boston, Mass.

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